

*ROTUMA LEWISI*, NEW GENUS AND SPECIES OF  
FISH FROM THE SOUTHWEST PACIFIC  
(GOBIOIDEI, XENISTHMIIDAE)

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*Abstract.*—*Rotuma lewisi* is described from two specimens, 18.0 and 19.3 mm SL, collected at Rotuma, about 12°30'S, 177°E. Xenisthmid and gobioid synapomorphies are discussed briefly, and some new synapomorphies are hypothesized for both groups.

The main purpose of this study is to describe a distinctive new genus and species of xenisthmid gobioid fish. The species is known from only two specimens collected during an expedition to the island of Rotuma in May, 1986.

Springer (1983) defined the gobioid subfamily Xenisthminae (accorded familial status by Hoese 1984), primarily on the basis of three synapomorphies: lower lip with an uninterrupted, free ventral margin, premaxillary ascending processes greatly reduced or absent, and the presence of a relatively large rostral bone, which replaces both ascending processes in position and, presumably, function. Homoplasies of these synapomorphies are unknown among other gobioids.

Springer (1983) proposed other osteological characters as possible synapomorphies of the Xenisthmidae, but he was uncertain of them as he lacked (still lacks) skeletal material for two of the four included genera (*Allomicrodesmus* and an undescribed genus, D. F. Hoese, in litt.): loss of basibranchials 2-4, hypobranchial 3 lost or vestigial, loss of coronomeckelian and pterosphenoid bones. The new genus and species described below exhibits all these possible synapomorphies except for two, loss of basibranchial 4 and the pterosphenoids, which, therefore, should be excluded as synapomorphies of the family.

I now hypothesize an additional xenisthm-

mid synapomorphology: 5th ceratobranchial entirely rod-like. All other gobioids I have examined have the teeth-bearing dorsal or posterodorsal surface of the 5th ceratobranchial considerably broadened. A new gobioid synapomorphology is hypothesized in the discussion section under character 30.

Springer's (1983) Xenisthmidae included *Xenisthmus* Snyder, *Tyson* Springer, *Allomicrodesmus* Schultz, and an undescribed genus and species (D. F. Hoese, in litt.; henceforth, referred to as HUGS) different from the one herein described. Except for *Xenisthmus*, which comprises about fifteen species, all the xenisthmid genera, are monotypic, and all, with the possible exception of *Xenisthmus* and HUGS, are radically different from each other in general morphology. Hoese has informed me that HUGS appears to be similar to *Xenisthmus*, but that HUGS has vomerine and palatine teeth. Because of its striking dissimilarity to the other xenisthmid genera, I have elected to recognize a separate genus for my new species.

A cladistic analysis of the Xenisthmidae would be desirable, but is not feasible because of the lack of information on *Allomicrodesmus* and HUGS, and because a phylogenetic classification of higher level gobioid groups (families, subfamilies) has not been hypothesized (i.e., outgroup relationships are unknown).

*Methods.*—Methods are those described

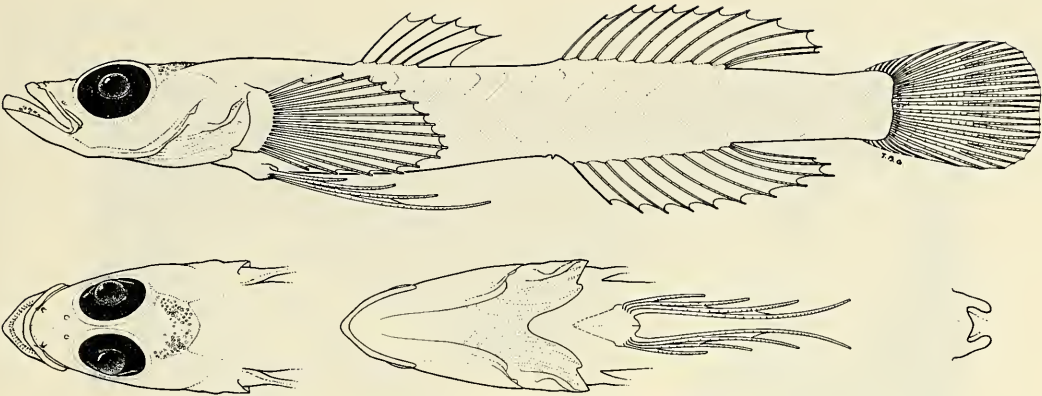


Fig. 1. *Rotuma lewisi*, USNM 280289, paratype, 18.3 mm SL, with dorsal views of head, ventral view of head and thoracic region, and urogenital papilla (much enlarged relative to other drawings).

by Springer (1983), except that I bow to convention and enumerate the last two elements as one in the dorsal and anal fins of all the genera except *Allomicrodesmus*. In all but *Allomicrodesmus*, the posteriormost pterygiophore in the dorsal and anal fins each support two rays, or in the common idiom, the last ray is split through the base. These two rays are closely applied to each other and the ray more posterior is much smaller than its mate. In *Allomicrodesmus*, the last pterygiophore in the dorsal and anal fins supports a single ray, which is similar in size and well removed posteriorly from the next ray anteriorly. To treat these last two rays as one in *Allomicrodesmus* would be misleading, although only slightly more so than the current treatment of the split-ray condition. (Hoes 1984, failed to note that the terminal dorsal- and anal-fin rays in *Allomicrodesmus* are not split through the base and, thus, counted each pair of terminal rays as two rays.)

Although among the Xenisthmidae there appears to be no intrageneric or intraspecific variation in the number of elements articulating with the terminal dorsal- and anal-fin pterygiophores, I (Springer 1967:5) have found such variation in the unrelated Blenniidae. The possibility exists, therefore, that similar variation could occur among gobioids.

I have used the convention described in Birdsong et al. (1988) in reporting the 1st dorsal-fin pterygiophore interdigitation formula in Table 1.

I rely mainly on the illustrations and Table 1 as constituting the description and comparison of *Rotuma lewisi*. The text consists mostly of a listing of available information on HUGS and *Allomicrodesmus* and general discussions and elaboration of the characters in Table 1.

*Material.*—The osteology of *Rotuma* (Figs. 2–8) is based on the paratype. I prepared the initial drawings, which were rendered in final form by T. B. Griswold, who also drew Fig. 1.

Information I present on HUGS was provided by D. F. Hoes. Information I present on *Allomicrodesmus* was obtained from examination and radiographs of the holotype of *A. dorotheae* (National Museum of Natural History (USNM) 113960; 20.9 mm SL) and another specimen (Australian Museum (AMS) I.18740-100; 19.8 mm SL).

*Rotuma*, new genus

*Diagnosis* (see also Table 1).—Most readily differentiated externally from other xenisthmids in having the following combination of characters: five spines in the anterior dorsal fin; four obvious, simple, seg-

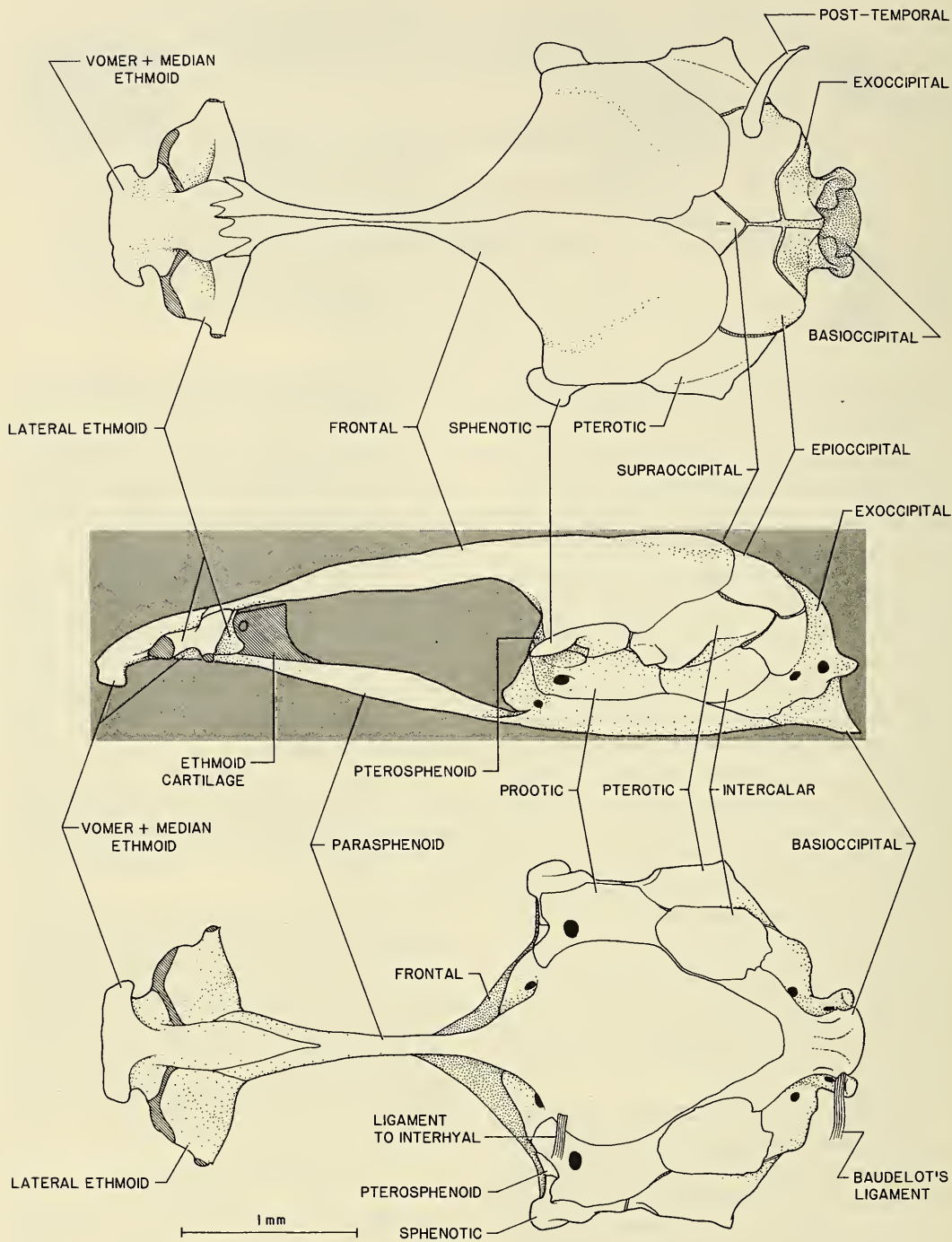


Fig. 2. *Rotuma lewisi*, USNM 280289, cranium (diagonal hatching represents cartilage anteriorly; unstained connective tissue in joints between epioccipitals, exoccipitals, and pterotics posteriorly): *top*, dorsal view; *middle*, lateral view; *bottom*, ventral view.



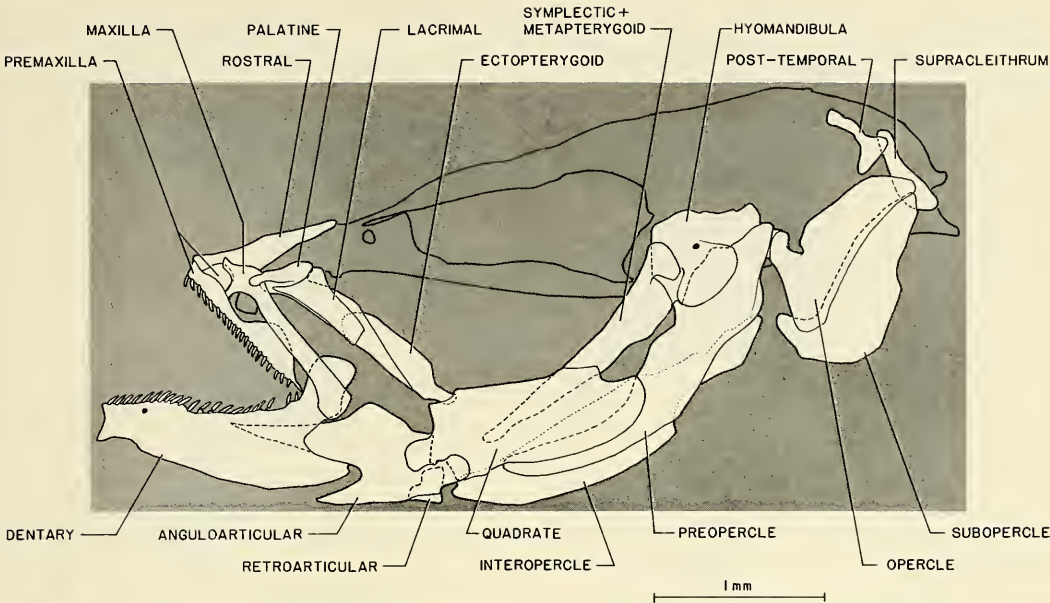


Fig. 3. *Rotuma lewisi*, USNM 280289, lateral view of superficial bones, jaws and suspensorium. (The limits of some bones obscured by others are indicated by dashed lines; see Figs. 4a and 4b for dorsoanterior view of snout and medial view of hyomandibular region.)

mented rays in each pelvic fin (a vestigial fifth ray is noticeable in the osteological preparation); scales lacking.

*Remarks.* — Schultz (1966) described *Kraemerius chapmani* from a single small specimen (16 mm SL), which he reported and/or illustrated as having five spines in the anterior dorsal fin, four simple, seg-

mented pelvic-fin rays, and scales. Both I and D. F. Hoese have examined the holotype and believe it to be a young specimen of a *Xenisthmus* species. A radiograph of the holotype clearly shows that it has six spines in the first dorsal fin.

Using transmitted light and a high resolution Leitz dissecting microscope, I could

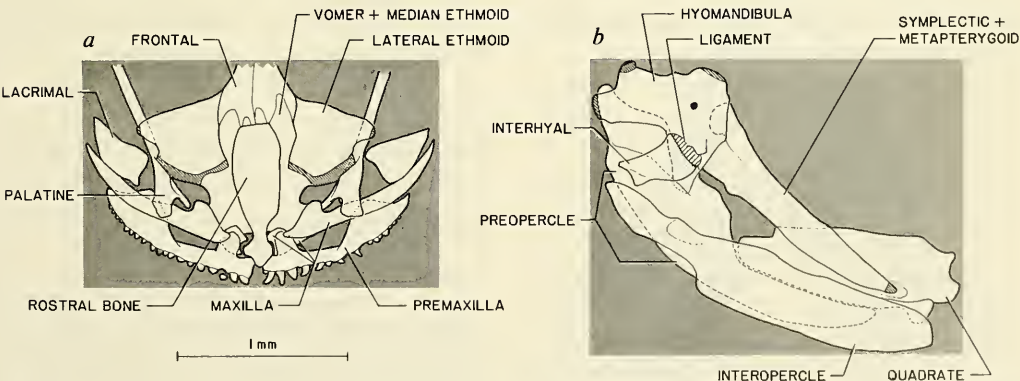


Fig. 4. *Rotuma lewisi*, USNM 280289: a, dorsoanterior view of snout region (frontals and palatines truncated posteriorly); b, medial view of hyomandibular region.

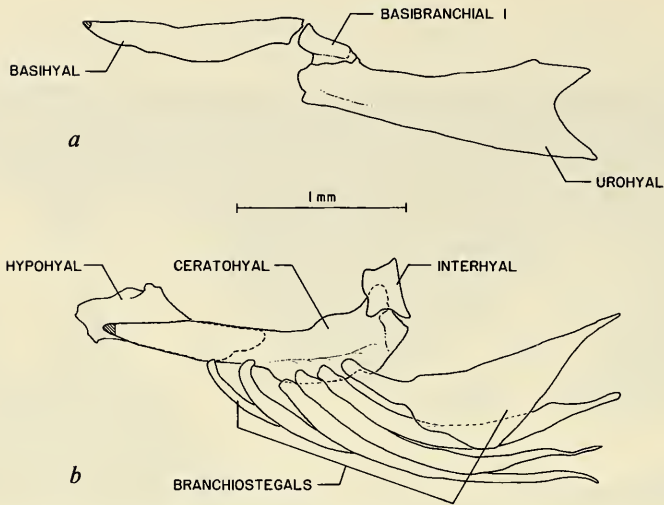
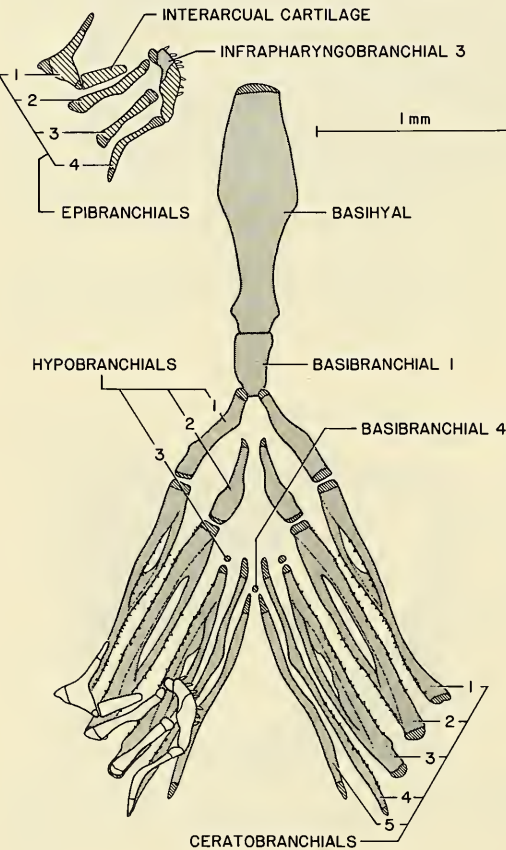


Fig. 5. *Rotuma lewisi*, USNM 280289: *a*, lateral view of urohyal, basibranchial 1, and basihyal; *b*, lateral view of left hyoid arch, rotated clockwise about long axis.



recognize a spine and four simple rays in each pelvic fin of the holotype of *Kraemer-icus chapmani*. Adults of *Xenisthmus* species typically have a spine and five rays, of which the posteriormost may vary from obvious, segmented, and branched to inconspicuous, unsegmented, and simple, depending on the species and size of the specimen. In small specimens of *Xenisthmus*, such as the holotype of *K. chapmani*, the posteriormost pelvic-fin ray may be indiscernible in unstained specimens.

Hoese has noticed (in litt.), and I confirm, that the presence of branched fin-rays in all the fins of *Xenisthmus* is correlated with the size of the specimen. I find that at least some of the fin-rays are branched in each fin in specimens of 18 mm SL. Hence, I believe that in the other genera (all of which are

Fig. 6. *Rotuma lewisi*, USNM 280289, dorsal view of gill arches and basihyal (right-side dorsal elements removed; left-side dorsal elements illustrated both in place and separately; except for the teeth and a small ossification of infrapharyngobranchial 3, the dorsal elements are entirely cartilaginous).

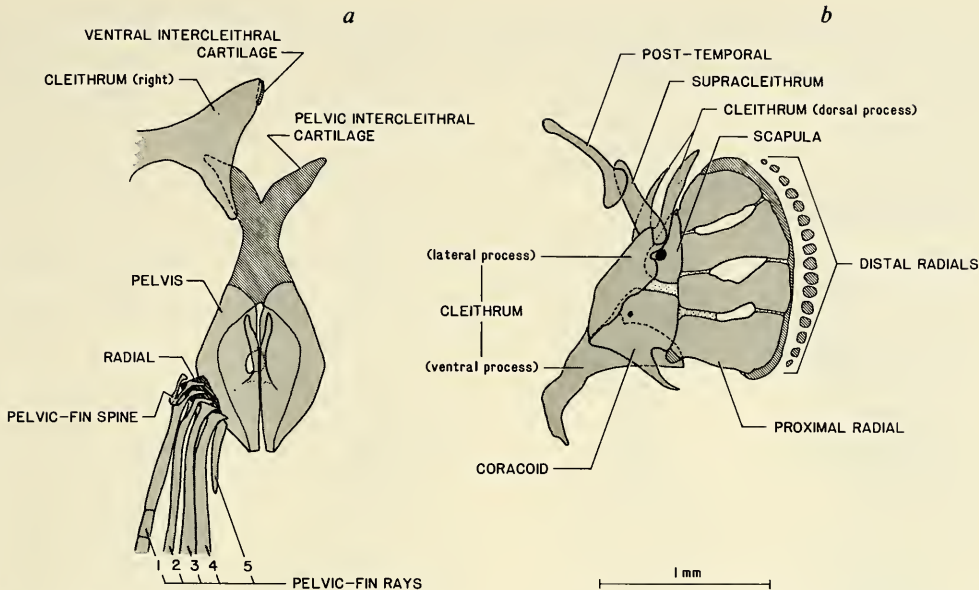


Fig. 7. *Rotuma lewisi*, USNM 280289: *a*, ventral view of pelvic-fin region (right fin-ray elements truncated; left elements and cleithrum removed; radial is cartilaginous); *b*, lateral view of pectoral fin and supports (fin-ray elements removed; unstained connective tissue present in areas between scapula and coracoid and between proximal radials proximally; distal radials and distal ends of proximal radials cartilaginous).

represented by specimens 18 mm SL or longer), those fins that I characterize as having only unbranched rays will not develop branched rays.

*Etymology*.—The generic name is derived from the island of Rotuma, where both known specimens were collected. Gender, masculine. The stem for formation of family-group and higher level taxa is “rotum.”

*Type species*.—*Rotuma lewisi* Springer, by original designation and monotypy.

*Rotuma lewisi*, new species  
Figs. 1–8

*Holotype*.—USNM 280290; 19.0 mm SL; immature (male?); Rotuma (ca. 12°30'S, 177°05'E), NE corner, just W of wharf, isolated patch reef in about 10.7 m; coll. 12 May 1986 by G. D. Johnson, J. D. Libbey, V. G. Springer, J. T. Williams.

*Paratype*.—USNM 280289; 18.3 mm SL; immature (female?); Rotuma, E side, just N of Afnaha Island, rock and coral wall, 13.7 m at base; coll. 18 May 1986, same collec-

tors. Specimen now cleared, stained, and dissected.

*Diagnosis*.—See under *Rotuma*.

*Etymology*.—Named for Dr. Anthony D. Lewis in recognition of his support of my field work in Fiji.

Discussion

Numbered paragraphs in this section refer to numbered characters in Table 1. Information on HUGS and *Allomicrodesmus* is limited and I have not included these two genera in Table 1. Their characters, as far as known, are reported below.

1. HUGS has scales; *Allomicrodesmus* is naked.

2. HUGS has 6 spines in the first dorsal fin; *Allomicrodesmus* has 2.

3. HUGS has I, 11 rays in the second dorsal fin; *Allomicrodesmus* has no spine and 30 (AMS) or 33 (holotype) segmented rays. Springer (1983) reported that the holotype of *Allomicrodesmus dorotheae* had only 32 rays, which it actually does, but there is an



Table 1.—Comparison of characters among three genera of Xenisthmidae (\* in character 5 denotes pterygiophore does not support spine)

Characters	Genera	<u>Xenisthmus</u>	<u>Rotuna</u>	<u>Tyson</u>
1. Scales		present	absent	absent
2. First dorsal-fin		VI	V	absent
3. Second dorsal fin		I, 11 to 15	I, 9	I, 8 or 9
4. Branched dorsal-fin rays		present	absent	absent
5. 1st dorsal-fin pterygiophore interdigitation formula		3-2, 2, 1, 1, 0	3-1, 2, 2, 1*, 0 <sup>(3)</sup>	0 <sup>(12)</sup>
6. 2nd dorsal-fin pterygiophores		1 per interneural space	1 or 2 per interneural space	2 per interneural space
7. Anal-fin formula		I, 10 to I, 14	I, 9	I, 8 of 9
8. Anal-fin pterygiophores		1 per interneural space	1 or 2 per interneural space	1 to 3 per interneural space
9. Anal-fin pterygiophores preceding 1st hemal spine		2	1	1
10. Branched anal-fin rays		present	absent	absent
11. Pectoral-fin rays		15 to 17	16	17 to 21
12. Branched pectoral-fin rays		present	absent	absent
13. Segmented pelvic-fin rays		5	5 (5th vestigial)	1
14. Pelvic-fin spine		well developed	vestigial	absent
15. Branched pelvic-fin rays		outermost 4 in adults	absent	absent
16. Caudal procurent rays		8 dorsal, 7 ventral <sup>1</sup>	6 dorsal, 6 ventral	8 or 9 dorsal, 9 ventral
17. Caudal segmented rays		17	17	15
18. Total caudal elements		32 <sup>1</sup>	29	32 or 33
19. Precaudal vertebrae		10	11	13
20. Caudal vertebrae		16 or 17	15	13
21. Total vertebrae		26 or 27	26	26
22. Epipleural ribs on		vertebrae 1 to 15 or 16	vertebra 2 only	vertebra 2 only
23. Pleural ribs on		vertebrae 3 to 10	vertebrae 3 to 11	vertebrae 3 to 10
24. Hypural 5		present	present	absent
25. Epurals		2	1	1
26. Post-temporal		ventral process present	ventral process absent	ventral process absent
27. Cleithrum, dorsal process		deeply notched	deeply notched	shallowly notched
28. Cleithrum, lateral process		notched dorsally	notched dorsally	unnotched dorsally
29. Pelvis		ossified	ossified	unossified
30. Pelvic-fin radial		autogenous	autogenous	undifferentiated from pelvis
31. Scapula & coracoid		both ossified, autogenous	both ossified, autogenous	partially ossified plate
32. Proximal pectoral-fin radials		ossified, autogenous	ossified, autogenous	undifferentiated cartilaginous plate
33. Sensory canal pores on head		present	absent	absent
34. Lateral extrascapulae		present	absent	absent

aberrant, rayless gap amid the fin where a ray should be present. Springer also indicated that the two dorsal fins of *Allomicrodesmus* were continuous, but they are not.

4. HUGS has branched dorsal-fin rays; *Allomicrodesmus* has only simple rays.

5. Based on a radiograph, the first dorsal-fin pterygiophore interdigitation formula of *Allomicrodesmus* appears to be 6-1, 1, 0. This formula should be verified in a counter-stained skeletal preparation as reduced, cartilaginous pterygiophores, which appear to

be present in *Allomicrodesmus*, are often indiscernible on radiographs. I lack information on the formula for HUGS.

7. HUGS has I, 10 anal-fin rays; *Allomicrodesmus* has 0, 24 or 26 (latter in the holotype; Springer 1983, erred in reporting 25 rays in the holotype).

10. HUGS has branched rays in dorsal fin; *Allomicrodesmus* has only unbranched rays.

11. HUGS has 18 pectoral-fin rays; *Allomicrodesmus* has 10.

Table 1.—continued

Characters	Genera	<u>Xenisthmus</u>	<u>Rotuma</u>	<u>Tyson</u>
35. Rostral bone		relatively small	relatively large	relatively large
36. Nasal bone		present	absent	absent
37. Lacrimal		present	present	absent
38. Metapterygoid		autogenous	fused with symplectic	absent
39. Retroarticular		present	present	absent (fused to anguloarticular?)
40. Vomerine teeth		absent	absent	present
41. Vomer		autogenous	fused with median ethmoid	fused with lateral and median ethmoids
42. Lateral ethmoid		autogenous	autogenous	fused with vomer and median ethmoid
43. Median ethmoid		autogenous	fused with vomer	fused with vomer and lateral ethmoids
44. Supraoccipital		autogenous	autogenous	undifferentiated
45. Pterospheneid		undifferentiated	autogenous	undifferentiated
46. Sphenotic & pterotic		autogenous	autogenous	fused together
47. Intercalar		present	present	absent
48. Baudelot's ligament attached proximally to		basioccipital	basioccipital	basioccipital & 1st vertebra
49. Matching condyles on first vertebra and exoccipitals		present	present	absent
50. Dorsal & ventral hypophyses		autogenous or fused together	fused together	fused together
51. Anterior & posterior ceratohyals		autogenous	fused together	fused together
52. Basihyal		see Springer, 1983:fig. 11	Figure 6	see Springer, 1983:fig. 13
53. Basibranchial 1		cartilaginous	ossified	ossified
54. Basibranchial 4		absent	present (vestigial)	absent
55. Hypobranchial 3		vestigial or absent	absent	vestigial
56. Ceratobranchials 1 to 3		rod-like	double-strutted	rod-like
57. Ceratobranchial 1		with well-developed gill rakers	with fine teeth	edentate
58. Ceratobranchials 2 to 4		with well-developed tooth patches	with fine teeth	edentate
59. Ceratobranchial 5		with fine teeth	edentate	with well-developed teeth
60. Epibranchial 1		ossified	cartilaginous	cartilaginous
61. Epibranchial 1		with uncinat process	with uncinat process	lacks uncinat process
62. Epibranchial 1		with gill rakers	edentate	edentate
63. Interarcual cartilage		present	present	absent
64. Infrapharyngobranchial 1		present (vestigial)	absent	absent
65. Infrapharyngobranchial 2		present	absent	absent
66. Infrapharyngobranchial 4		present	absent	absent

<sup>1</sup>Incorrectly reported to comprise one less element in Springer (1983).

12. HUGS has all but the uppermost and lowermost pectoral-fin rays branched; *Allomicrodesmus* has only simple pectoral-fin rays.

13. HUGS has I,5 pelvic-fin rays. *Allomicrodesmus* has three obvious segmented pelvic-fin rays (presence of spine and vestigial rays unknown).

15. Both HUGS and *Allomicrodesmus* have only simple pelvic-fin rays.

16. HUGS has 8 dorsal and 6 or 8 ventral

procurrent (unsegmented) rays. *Allomicrodesmus* has 8 dorsal and 7 ventral procurrent rays (based only on holotype).

17. HUGS has 17 and *Allomicrodesmus* has 15 segmented caudal-fin rays.

18. HUGS has 31 or 33 and *Allomicrodesmus* has 30 total caudal-fin elements (based only on holotype of *A. dorotheae*).

19–21. *Allomicrodesmus* has 18 + 25 or 27 = 43 or 45 vertebrae.

30. Springer (1983) in discussing various



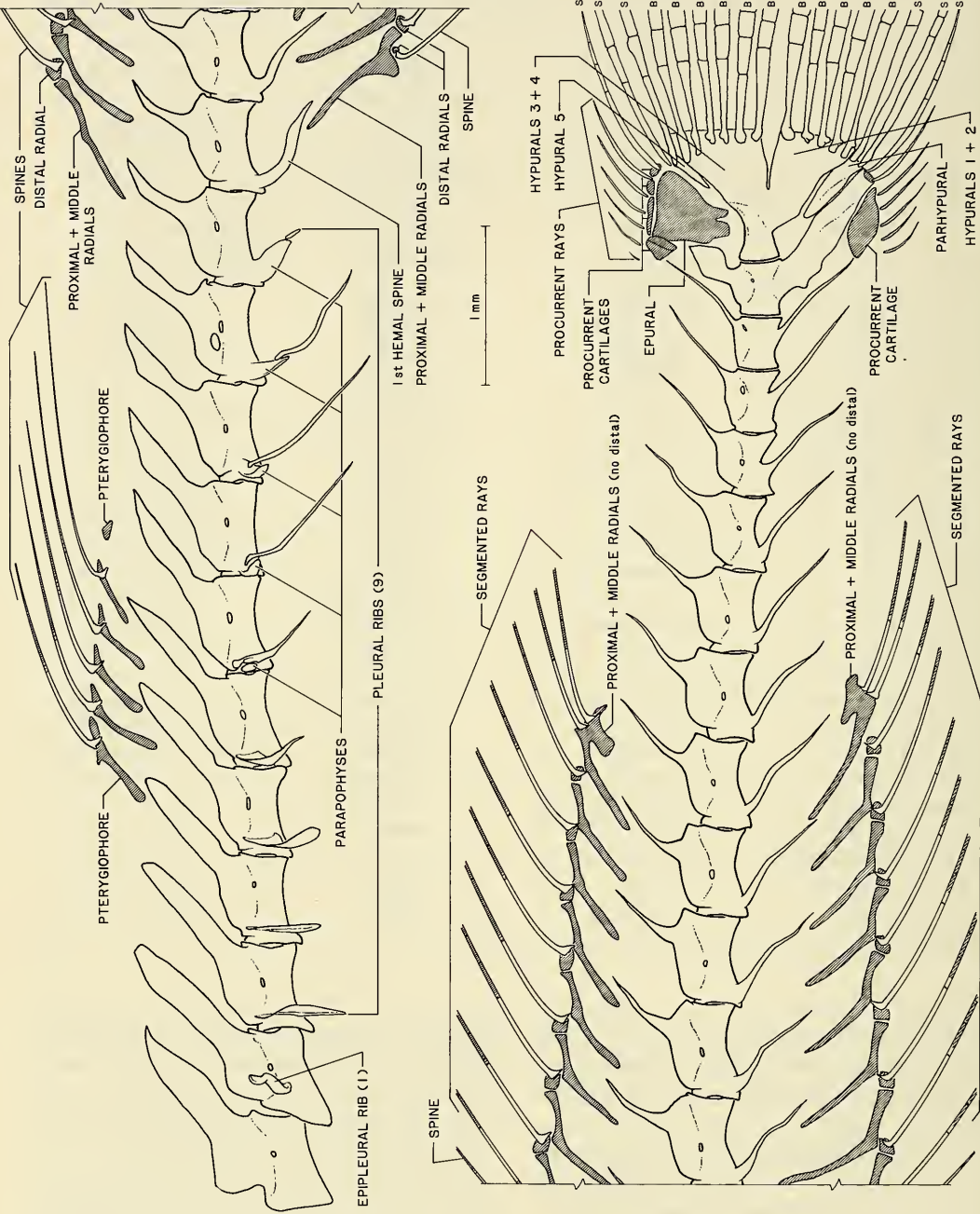


Fig. 8. *Rotuma lewisi*, USNM 280289, vertebrae and unpaired fins (segmented rays truncated; cartilaginous elements indicated by diagonal hatching).

gobioid characters, did not stress that a single, relatively large, cartilaginous radial was present in the pelvic fin of almost all gobioids. The radial (one in each fin), like the median pelvic intercleithral cartilage, is apparently an unossified portion of the initial, median cartilaginous block that gives rise to both of the ossified pelvises.

The radial supports all or most of the pelvic-fin elements, and is probably a synapomorphy of the Gobiioidei, or the Gobiioidei less the Rhyacichthyidae. In the Rhyacichthyidae, the homologue of the radial in the other gobioids is represented only by a thin layer of cartilage covering the lateral edge of the pelvis in the region embraced by the bases of the fin elements. In *Tyson*, the radial is autapomorphically undifferentiated (Springer 1983:fig. 16c) from the pelvis because the cartilaginous block that gives rise to the pelvises does not ossify. In the eleotridid *Butis amboinensis* (Springer 1973: listed in material), there are two radials in each fin, a block-like one anteriorly that supports all but the posteriormost ray, and a smaller ball-like one that supports the posteriormost ray.

40. HUGS has vomerine (and palatine) teeth. I was unable to determine the state of this character for *Allomicrodesmus* as I could not open the jaws of the holotype without causing damage to the specimen.

56. The double-strutted ceratobranchials 1–3 of *Rotuma* appear to be unique among all fishes. It would be desirable to verify this condition in another specimen of *Rotuma*.

65. Only the left side dorsal elements were illustrated in Fig. 6. Just anterior to infrapharyngobranchial 3 on the right side, is a tiny fragment of cartilage that possibly represents a vestigial infrapharyngobranchial 2.

#### Acknowledgments

I thank Dr. D. F. Hoese (AMS) for providing information on HUGS and ontogeny

of fin-ray branching in gobioids, and Drs. G. D. Johnson and J. T. Williams (USNM) for discussions during the course of my work and for commenting on the manuscript. Dr. R. S. Birdsong (Old Dominion University) reviewed the manuscript and provided constructive suggestions for its improvement (he also correctly noted that Springer 1983: fig. 6, was in error in indicating that the lateral ethmoids met in the midline above the lateral ethmoid; the correct condition of the ethmoids is illustrated in fig. 3 of the same study). I am indebted to Dr. A. D. Lewis, Fisheries Officer, Government of Fiji, and Mr. R. Fonmoa, Malhaha District, Rotuma, for making arrangements and granting permission for field work in Rotuma. Financial support for field work during which the new species was collected was provided by a grant from the Max and Victoria Dreyfus Foundation.

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